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U.S. Department
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PESTS NOT KNOWN TO OCCUR IN THE UNITED STATES OR OF LIMITED
DISTRIBUTION, NO. 69: POTATO CYST NEMATODE

APHIS-PPQ

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Pest

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Synonyms

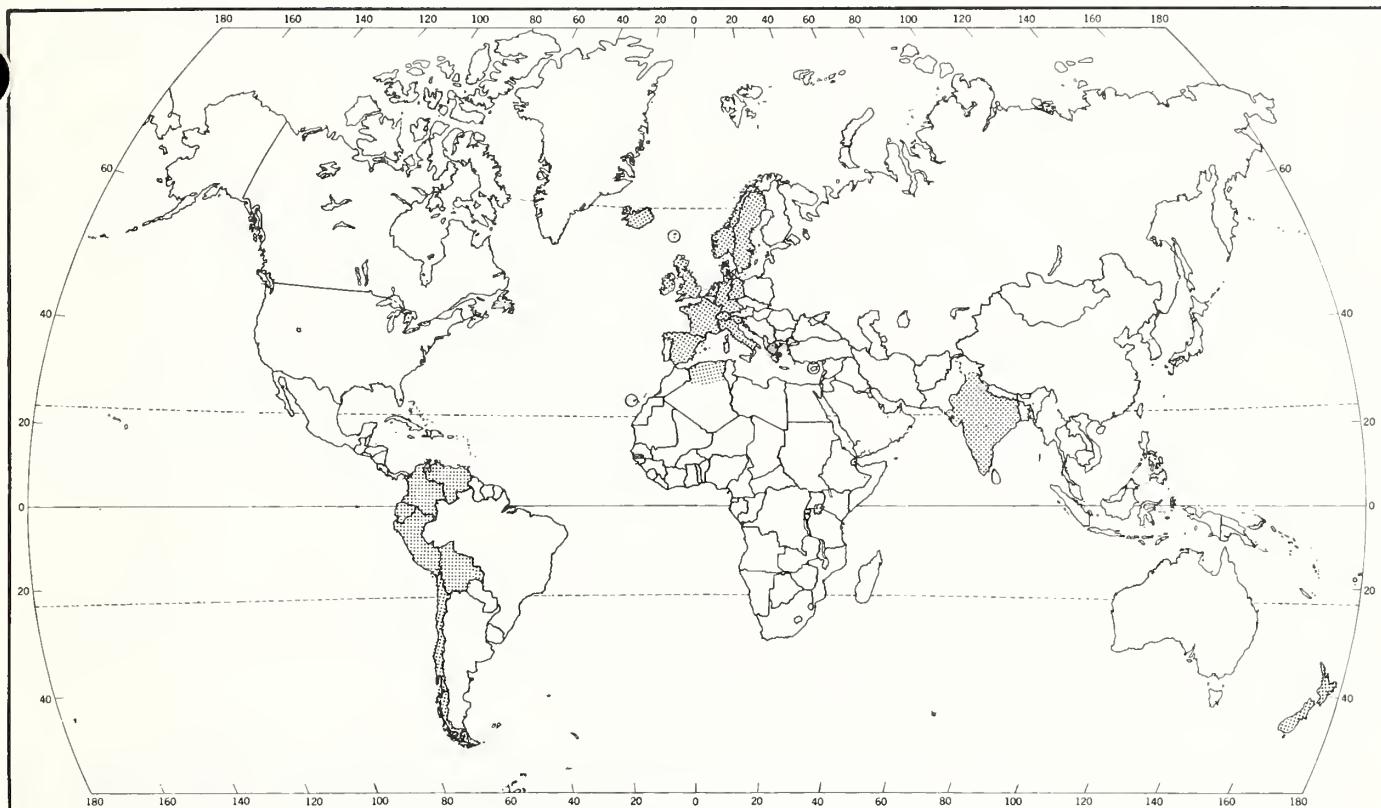
POTATO CYST NEMATODE
Globodera pallida (Stone) Behrens

Order: Family

Heterodera pallida Stone

Economic
Importance

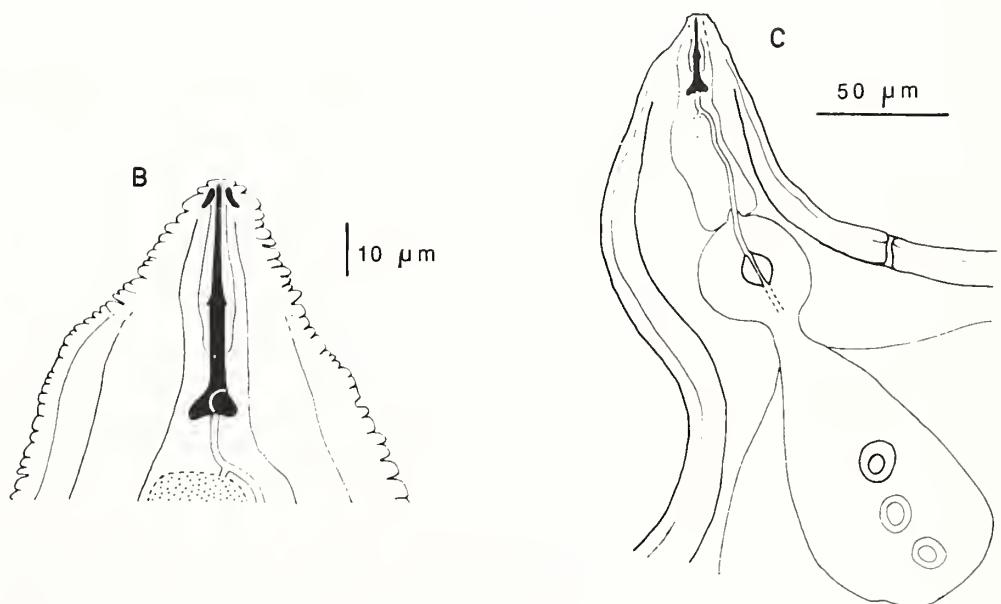
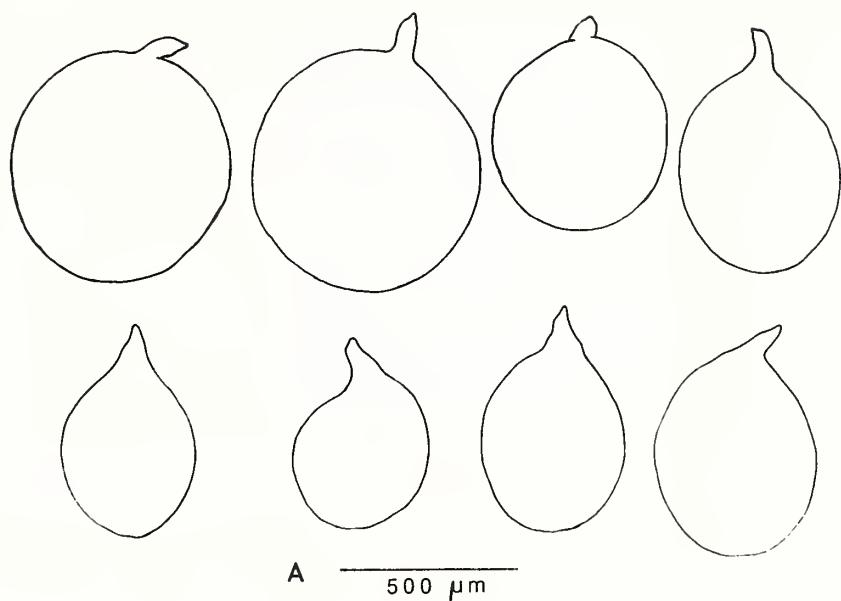
If left uncontrolled, potato cyst nematodes can cause total loss in potato yields (Brodie 1984). Chemical treatment of soils containing G. pallida increased yields 10-25 tons per hectare when the treatment significantly reduced the nematode population (Brown 1983). While losses depend primarily on nematode population density, other factors, such as potato cultivar, soil type, moisture, planting and harvesting time, and fertilizer use, also affect yield.



Globodera pallida distribution map (Prepared by Non-Regional
Administrative Operations Office and Biological Assessment
Support Staff, PPQ, APHIS, USDA).

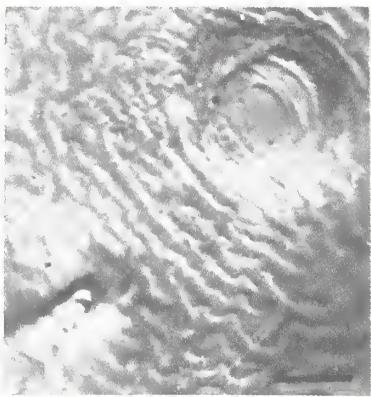
General Distribution	Algeria, Bolivia, Canada (Newfoundland), Channel Islands, Chile, Colombia, Cyprus, Denmark, East Germany, Ecuador, Faeroe Islands, France, Greece, Iceland, India, Ireland, Italy, Netherlands, New Zealand, Norway, Peru, Spain (includes Canary Islands), Sweden, Switzerland, United Kingdom, Venezuela, and West Germany.
Hosts	<u>Lycopersicon esculentum</u> (tomato), <u>Solanum melongena</u> (eggplant), and <u>S. tuberosum</u> (potato) are the commonly cultivated plant hosts. Other species of the genus <u>Solanum</u> are also hosts.
Characters	<p>Data from Stone (1973) (measurements in micrometers).</p> <p>FEMALES (n = 25) - Stylet length = 27.4 ± 1.1, head width at base = 5.2 ± 0.5, stylet base to dorsal esophageal gland duct junction = 5.4 ± 1.1, head tip to median bulb = 67.2 ± 18.7, median bulb valve to level of excretory pore = 71.2 ± 21.9, head tip to level of excretory pore = 139.7 ± 15.5, mean diameter of median bulb = 32.5 ± 4.3, mean diameter of vulval basin = 24.8 ± 3.7, vulval slit length = 11.5 ± 1.3, anus to vulval basin = 44.6 ± 10.9, number of cuticular ridges on anus-vulva axis = 12.5 ± 3.1.</p> <p>Body subspherical with projecting neck (Fig. 1A), internal color white, cuticle brown after death. Cuticle never light yellow or golden. Some populations pass through 4 to 6-week internal cream stage before turning brown. Head with 1 or 2 annules, cephalic framework weakly developed. Stylet with rounded knobs sloping backward (Fig. 1B). Median bulb large with large valve (Fig. 1C). Esophageal glands broad (Fig. 1C), frequently displaced forward by paired ovaries. Excretory pore at base of neck (Fig. 1C). Vulva not set off from body, located opposite neck in slight almost circular depression. Anus small, at right angle to vulval slit. Cuticle reticulate, subcuticular punctations visible.</p> <p>CYSTS (n = 25) - Length (excluding neck) = 579 ± 70, width = 534 ± 66, neck length = 118 ± 20, fenestral diameter = 24.5 ± 5.0, anus to fenestra = 49.9 ± 13.4, anus to fenestral distance divided by fenestral diameter = 2.1 ± 0.9.</p> <p>Cyst brown, subspherical with protruding neck, abullate. Vulval region forming single circular fenestra in older cysts (Fig. 2). Anus small, may be at apex of V-shaped mark (Fig. 2). Cyst wall pattern similar to that of female but more pronounced. Generally punctate.</p>

(Fig. 1)



Globodera pallida female. A. Entire. B. Head. C. Neck region
(From Nematologica, courtesy E. J. Brill).

(Fig. 2)



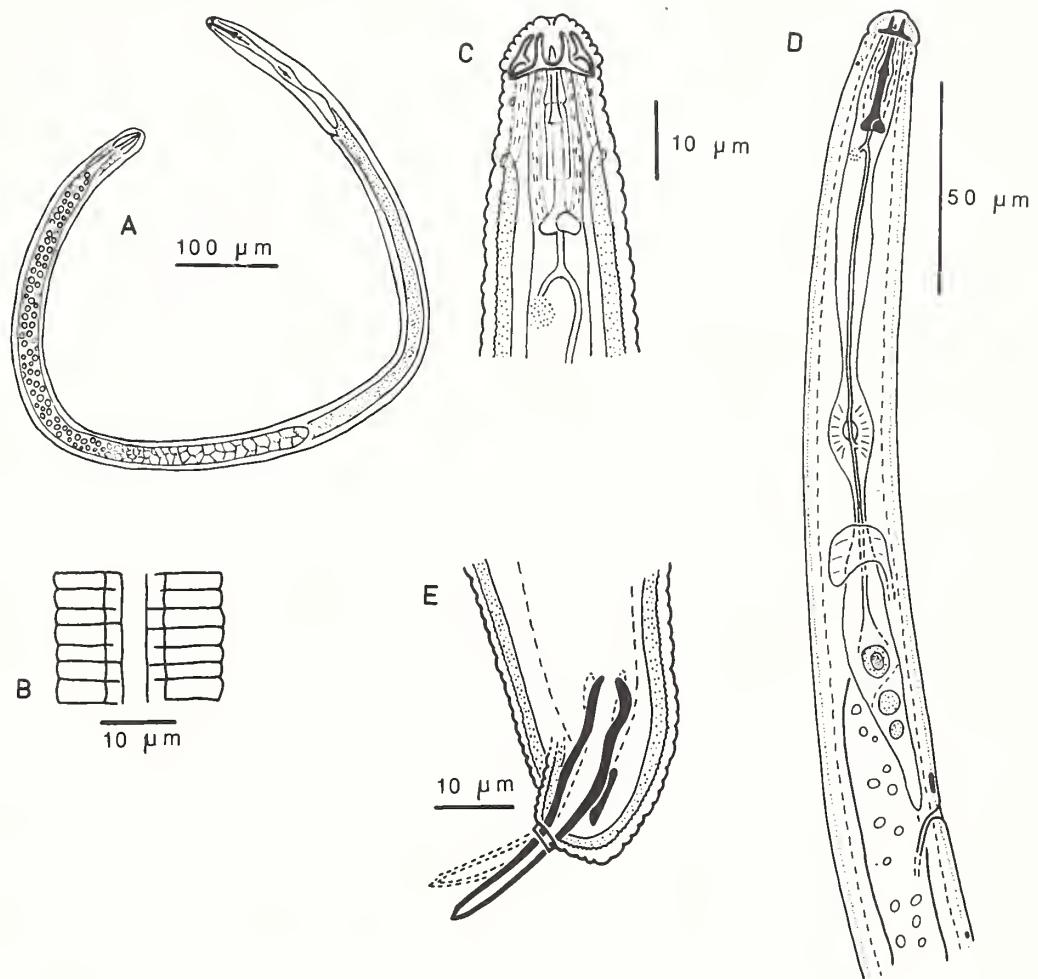
Globodera pallida cyst, anal-vulval region (From Nematologica, courtesy E. J. Brill).

MALES ($n = 50$) - Length = $1,198 \pm 104$, width at excretory pore = 28.4 ± 1.3 , head width at base = 12.3 ± 0.5 , head length = 6.8 ± 0.3 , stylet length = 27.5 ± 1.0 , stylet base to dorsal esophageal gland duct junction = 3.4 ± 1.0 , head tip to median bulb valve = 96.0 ± 7.1 , median bulb valve to excretory pore = 81.0 ± 10.9 , head tip to excretory pore = 176.4 ± 14.5 , tail length = 5.2 ± 1.4 , tail width at anus = 13.5 ± 2.1 , spicule length along axis = 36.3 ± 4.1 , gubernaculum length = 11.3 ± 1.6 .

Body vermiform (Fig. 3A), cuticular annulation prominent. Lateral field with 4 incisures, areolations sometimes cross outer incisures (Fig. 3B). Head rounded, offset, with 6-7 annules (Fig. 3C). Cephalic framework heavily sclerotized. Stylet strong with posteriorly sloping basal knobs (Fig. 3C). Median bulb elliptical with prominent valve (Fig. 3D). Esophageal glands narrow, ventral, terminating near excretory pore (Fig. 3D). Hemizonid 2 annules long, 2-3 annules anterior to excretory pore (Fig. 3D). Testis single (Fig. 3A). Spicules with single pointed tips (Fig. 3E). Gubernaculum small, about 2 μm across in side view, slightly broader in dorso-ventral aspect, without ornamentation (Fig. 3E). Phasmids not observed.

SECOND-STAGE JUVENILES ($n = 50$) - Length = 486 ± 23 , body width at excretory pore = 19.3 ± 0.6 , head width at base = 10.6 ± 0.5 , head length = 5.5 ± 0.1 , stylet length = 23.8 ± 1.0 , stylet base to dorsal esophageal gland duct junction = 2.7 ± 0.9 , head tip to median bulb valve = 68.7 ± 2.7 , median bulb valve to excretory pore = 39.9 ± 3.3 , head tip to excretory pore = 108.6 ± 4.1 , tail length = 51.1 ± 2.8 ; tail width at anus = 12.1 ± 0.4 , length of clear tail = 26.6 ± 4.1 .

(Fig. 3)

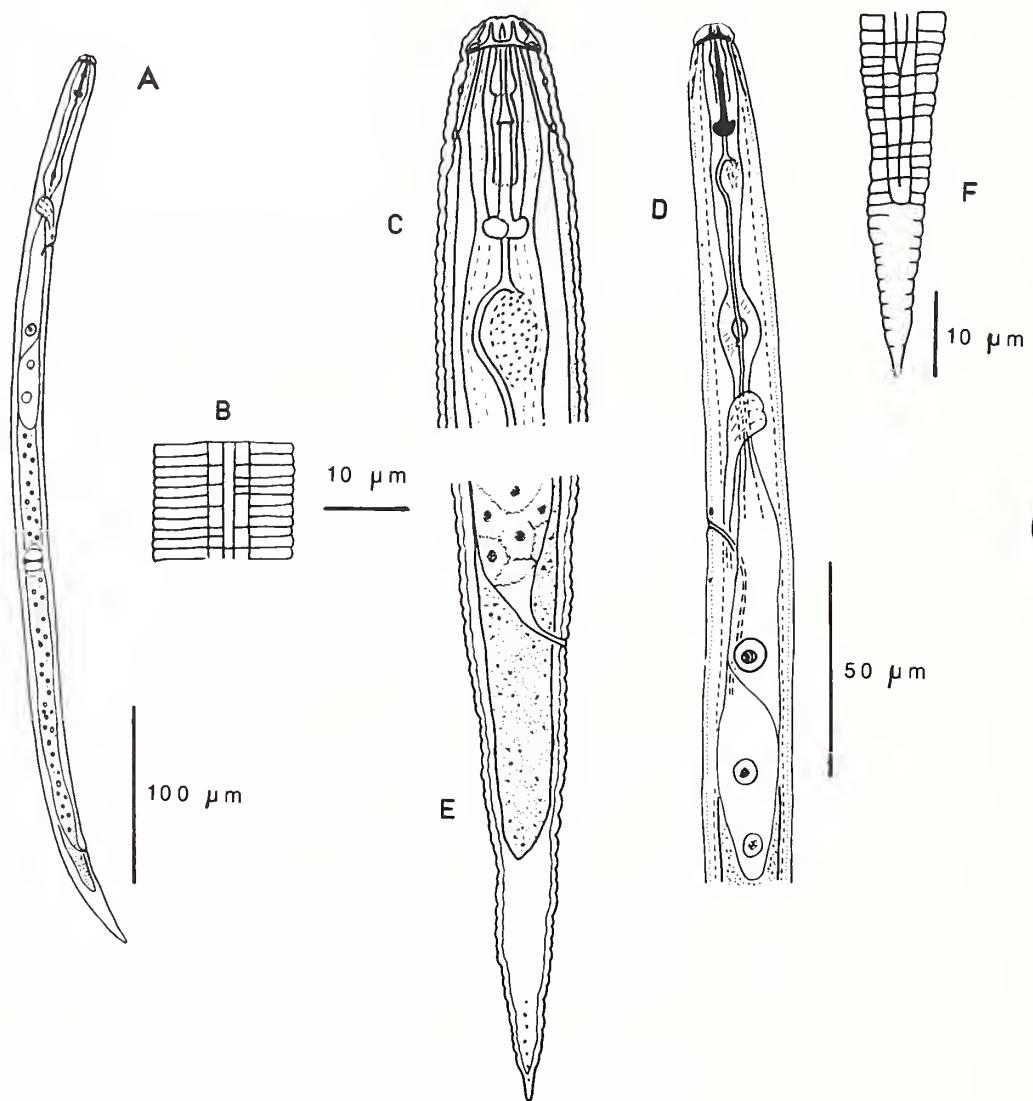


Globodera pallida male. A. Entire. B. Lateral field midbody region. C. Head. D. Anterior. E. Lateral view of tail (From Nematologica, courtesy E. J. Brill).

Body vermiform (Fig. 4A), cuticular annulation prominent. Lateral field with 4 incisures, occasionally completely areolated (Fig. 4B). Head rounded, slightly offset with 4-6 annules (Fig. 4C). Cephalic framework heavily sclerotized. Stylet well developed, basal knobs with distinct forward projection in lateral view (Fig. 4C). Median bulb elliptical with prominent valve (Fig. 4D). Esophageal glands extend ventrally for about 35 percent of body length (Fig. 4A). Hemizonid usually one annule anterior to excretory pore (Fig. 4D). Four-celled genital primordium at about 60 percent of body length (Fig. 4A). Tail tapers to finely rounded

terminus (Fig. 4E, F). Line of 2-8 small refractive bodies sometimes visible internally near tail end (Fig. 4E). Phasmids difficult to see, slightly anterior to middle of tail.

(Fig. 4)



Globodera pallida juvenile. A. Entire. B. Lateral field midbody region. C. Head. D. Anterior. E. Tail. F. Lateral field tail
(From Nematologica, courtesy E. J. Brill).

EGGS - Egg shell hyaline. Second-stage juveniles folded four times in egg.

While most literature separates G. pallida morphologically only from G. rostochiensis because both attack potatoes, G. pallida more closely resembles certain other species of Globodera. G. pallida cannot be reliably differentiated from the species occurring on tobacco in the analyses of juvenile or cyst measurements. It can be differentiated from all the nominal species by the mature female color, white or cream in G. pallida, yellow in the others (Stone 1983).

Characteristic
Damage

Plants showing symptoms appear in small areas of poor growth. Infected plants show symptoms that resemble water or nutrient deficiency. These plants are smaller than normal, have yellow leaves and may wilt during the hottest part of the day. In succeeding years, the patchy areas enlarge and additional patches appear. Fewer and smaller potato tubers are formed, reducing yield.

Detection
Notes

The Plant Quarantine Act of 1912 contained a prohibitory provision that applied to the fungus Synchytrium endobioticum (Schilbersky) Percival, potato wart. This helped prevent the introduction of potato cyst nematodes into the United States because potato wart and potato cyst nematodes are spread by similar methods.

Besides its hosts, G. pallida can be found in minute amounts of soil on many different plant and nonplant products entering the United States. Numerous interceptions have been made from root crops in ship's stores. G. pallida is less frequently intercepted at ports of entry than G. rostochiensis.

On imports, collect soil clinging to plant material by cutting off dirty roots or the base of bulbs. When soil is not apparent, tap or knock surface dust onto clean paper. Inspection stations can wash plant material over screens without cutting. Be alert for soil with nonplant cargoes.

In the field the most reliable method for detection is the collection of soil samples and processing by a wet screening method. Agricultural Handbook No. 353, The Golden Nematode Handbook, explains the survey and laboratory procedures in detail. Small populations are difficult to detect.

For identification, a minimum of 10 cysts with juveniles is desirable. Interceptions at ports of entry generally contain smaller numbers of cyst. Males, females, and the name of the host will help in identifying field infestations.

Biology

Most, if not all, of the infective second-stage juveniles overwinter coiled within their egg shells protected by the dead female body, the cyst. The juveniles are resistant to drying while in the egg protected by the cyst. In spring, secretions from host roots stimulate juveniles to emerge from their eggs. Juveniles escape from the cyst through the neck opening and the disintegrating cuticle around the short vulval slit (fenestra). They enter host roots just behind the tip. Invading juveniles induce the host to establish feeding cells or syncytia upon which they feed and develop through three molts to the adult stage. During this time, the posterior ends of their enlarging bodies have broken through the surface of the root. The vermiform, motile adult males emerge from the roots. They are attracted to the females, which are still attached to the roots, and mate with them. Impregnated females continue to feed and become filled with eggs, which develop to contain second-stage juveniles while within the female.

When the females die, their cuticles toughen and turn brown without going through a light yellow or golden phase, differentiating them from G. rostochiensis in the field. Each may contain from 200 to 500 embryonated eggs. At harvest when the roots are disturbed, the cysts are dislodged from the root surfaces and become free in the soil.

G. pallida develops more slowly than G. rostochiensis (McKenna and Winslow 1972) suggesting that G. rostochiensis competes better than G. pallida on short duration crops. G. pallida develops at lower temperatures than G. rostochiensis but more slowly than G. rostochiensis at those temperatures at which both develop (Foot 1978). G. pallida reproduces better than G. rostochiensis under shorter day lengths (Evans et al. 1975).

Control

No commercial potato cultivars resist G. pallida. Three races of G. pallida occur in Europe and an additional three races in South America (Brodie 1984).

Rotation time varies with the initial nematode density. Other factors such as soil type and soil temperature also affect the rate of decline of the population. At high nematode densities, it may take 4-7 years of a nonhost before potatoes can be grown without damage.

Selected
References

Brodie, B. B. Nematode parasites of potato. Nickle, W. R., editor. Plant and insect nematodes. New York: Marcel Dekker, Inc.; 1984.

Brown, E. B. The relationship of potato yield with and without nematicide to density of potato cyst nematodes, Globodera rostochiensis and G. pallida. Ann. Appl. Biol. 103:471-476; 1983.

Evans, K; Franco, J.; DeScurrrah, M. M. Distribution of species of potato cyst-nematodes in South America. Nematologica 21:365-369; 1975.

Foot, M. A. Temperature responses of three potato-cyst nematode populations from New Zealand. Nematologica 24:412-417; 1978.

Krall, E. Compendium of cyst nematodes. Nematologica 23:311-332; 1977.

McKenna, L. A.; Winslow, R. D. Differences in hatch and development rates of potato cyst nematode pathotypes. Ann. Appl. Biol. 71:274-278; 1972.

Spears, J. F. The golden nematode handbook: survey, laboratory, control and quarantine procedures. U.S. Department of Agriculture Handb. No. 353, Agricultural Research Service; 1968.

Stone, A. R. Heterodera pallida n.sp. (Nematoda: Heteroderidae), a second species of potato cyst nematode. Nematologica 18:591-606; 1973.

_____. Three approaches to the status of a species complex, with a revision of some species of Globodera (Nematoda: Heteroderidae). Stone, A. R.; Platt, H. M.; Khalil, L. F., editors. Concepts in nematode systematics. New York: Academic Press; 1983.

